Block 1-3 Quiz next class

Power

rate of doing work or changing energy

$P=W/t = \Delta Energy/t$

(note E is electric field strength, not energy, E_e is electric energy)

units: Watts, W = J/s

(horsepower = 746 W)

kilowatt-hour - unit of energy use

BC Hydro sells electric power at a rate of 10 cents per kilowatt-hour on average.

efficiency= (energy out/ energy in) x 100%

eg.

1. A 100 watt light bulb in your Christmas lights and you run it 8.0 hours a day for all year.

a) how much energy is used in Joules and kilowatt-hours

b) how much does it cost/year?

c) if you replace the bulb with a high efficiency bulb, rated at 25 watts for the same light output (less heat given off) how much money do you save a year?

2. You roll a marble down a slope into a 29.0 cm diameter vertical loop.

a) What is the minimum speed of the marble at the top of the loop to not fall out?

b) What height should you drop the marble to just make the loop? (ignore friction)

c) What is the acceleration of the marble as it enters the circular loop (at bottom).

d) What minimum height will the marble just make the loop including friction? - do some measurements or guessing.

3. A spring with a pencil - total mass 49.33g extends (66.5-60.0cm) with 200g on it and (66.5-53.5cm) with 400g on it. How far down should you stretch it to fire it to the ceiling a distance of 2.4 m above the

top of the spring?

$$P = \frac{\Delta E_{energy}}{time} \qquad \Delta E_{energy} = P \cdot t$$

$$P = \frac{W}{r}$$

(a) ~~$P = \frac{E_{energy}}{t}$~~ $E_{energy} = P \times t$

$$= 100W \times 8\,\frac{hrs}{day}\left(365.25\,\frac{d}{year}\right)$$

$$= 2.922 \times 10^{5}\ kWhrs$$

$$= \boxed{2.9 \times 10^{2}\ kWhrs}$$

$$\frac{3600s}{hr} \qquad \frac{1000J}{KJ}$$

$$\downarrow$$

$$\doteq 2.9 \times 10^{2}\ kWhrs\left(\frac{3600000\ J}{1\ kWhrs}\right)$$

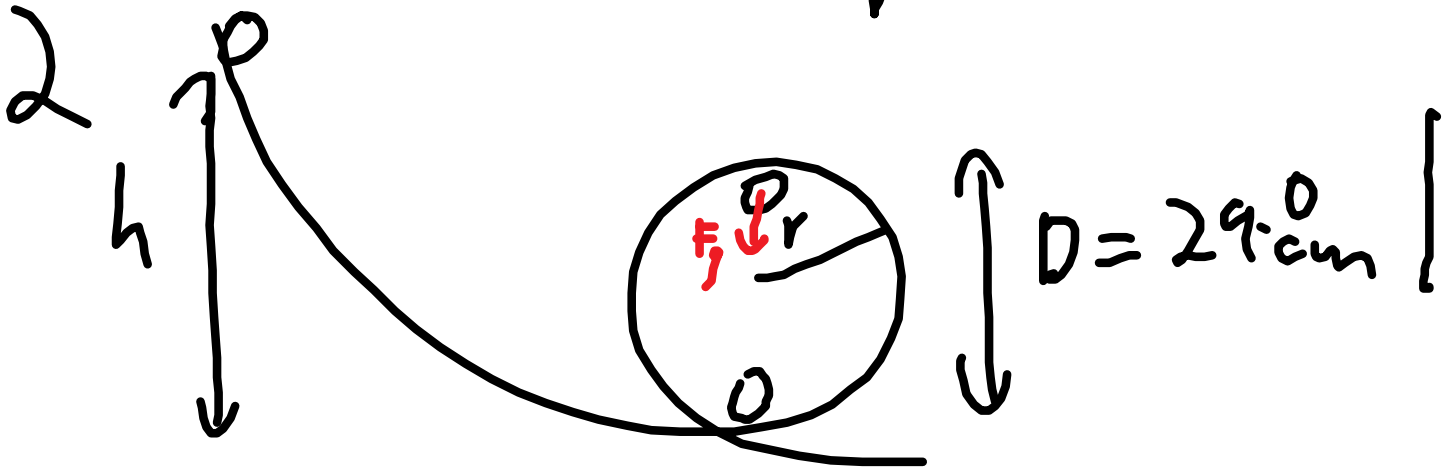
$$= \boxed{1.1 \times 10^{9}\ J}$$

b) $2.922 \times 10^3 \times \frac{10¢}{kwh} = \$29/year$

c) $\boxed{\$7.3/year}$ $\frac{1}{4}$ of $\$29$

$r = 14.5cm$

2



a) $F_g = F_c$ at top

$mg = m\frac{v^2}{r}$ $\quad v = \sqrt{gr}$

$v = \sqrt{9.8\,m/s^2\ 0.145m}$

$\boxed{v = 1.19\,m/s}$

b)

b) Total energy initial = Total energy final

~~$mgh = \frac{1}{2}mv^2$~~

$mgh = \frac{1}{2}mv^2 + mgD$

$gh = \frac{1}{2}(\sqrt{rg})^2 + gD$

$\frac{1}{2}h = \frac{1}{2}r + D$

$h = \frac{1}{2}r + 2r$

$\boxed{h = 2.5r}$

$h = 2.5\,(0.145) = 0.3625$ m

$= \boxed{36.25\text{ cm}}$

c) $a_c = \frac{v^2}{r}$ and $mgh = \frac{1}{2}mv^2$

$$a_c = \frac{2gh}{r} = \frac{2g(2.5R)}{R}$$

$$\boxed{a_c = 5g's}$$

Block 1-1
Power, P
The rate of doing work or the rate of change in energy.
P=W/t = Δenergy/t
units: Watts, W=J/s
(1 horsepower = 746W)

KWhr is a kilowatt-hour a unit of energy of the energy used or work done by a kW of power in an hour.
used to measure electrical use, BCHydro sells power at a rate of 8.0 cents/kWhr at low use and 12 cents at high use.

Energy = Pt

KWh=?J
1000 J/s (3600s) = 3.6 MJ

efficiency
= (useful energy out/ energy in) x 100%

eg.

1. A 100 watt light bulb in your Christmas lights is on for 8.0 hours a day all year.

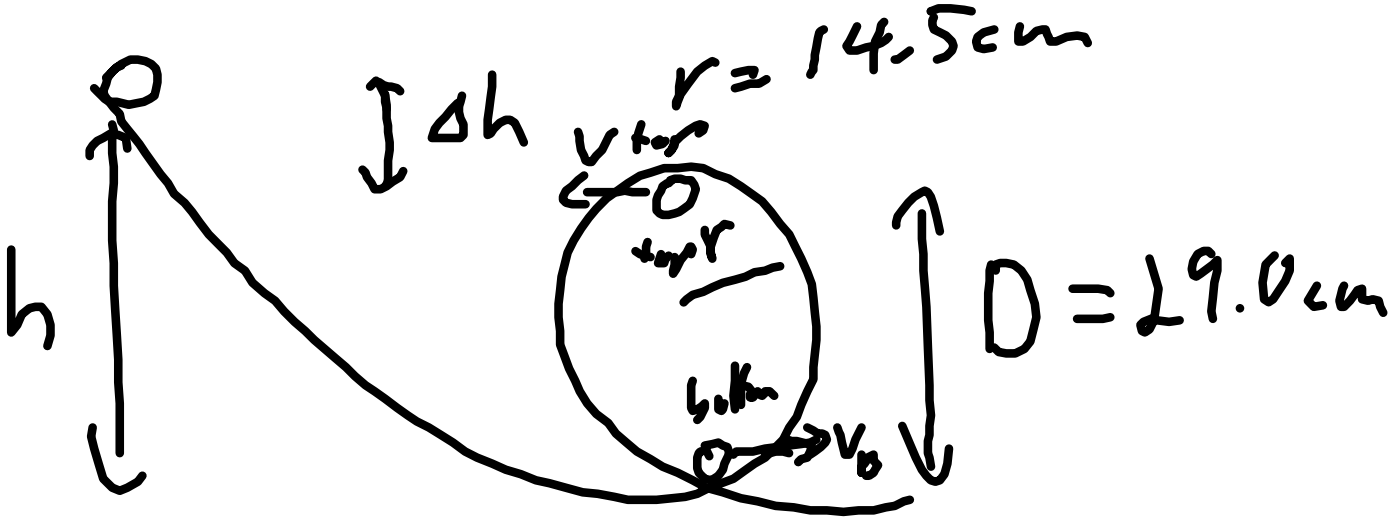
a) how much energy is used in Joules and kilowatt-hours
E=Pxt = 0.100kW x 8hr/d x 365.25 d/year
0.1x8x365.25=292.2 = 290kWhrs/year
292.2x3600000=1051920000
1.05×10^9 J/year

b) how much does it cost/year?
290 kWhrs /year x 0.12$/kWhrs
290x0.12=34.8 = $35/year high use

or 290x0.08=23.2 or $23/year low use

c) if you replace the bulb with a high efficiency bulb, rated at 25 watts for the same light output (less heat given off) how much money do you save a year?
you save 75%
high use, 0.75x34.8=26.1 $26/year
low use, 0.75x23.2=17.4 = $17

1. You roll a marble down a slope into a 29.0 cm diameter vertical loop.



a) What is the minimum speed of the marble at the top of the loop to not fall out?

Fc=Fg no normal force at minimum speed

$mv^2/r=mg$

$v^2=gr$

$v=\sqrt{gr} = \sqrt{9.8m/s^2 0.145m}$

= 1.19m/s

b) What height should you drop the marble to just make the loop? (ignore friction)

$mgh = 1/2\ mv^2 + mgD$ D is diameter

since $v=\sqrt{gr}$

$gh = 1/2\ (gr) + gD$

$h = 1/2\ r + D$

$h = 2.5r$ - note independent of g

h = 36 cm

c) What is the acceleration of the marble as it enters the circular loop (at bottom).

$a_c=v^2/r$ and $mgh = 1/2mv^2 + 0$ (at bottom)

$v^2 = 2gh$

$a_c= 2gh/r\ 2g(2.5r)/r = 5gs$

$a_c = 49m/s^2$

d) What minimum height will the marble just

make the loop including friction? - do some measurements or guessing.

3. A spring with a pencil - total mass 49.33g extends (66.5-60.0cm) with 200g on it and (66.5-53.5cm) with 400g on it. How far down should you stretch it to fire it to the ceiling a distance of 2.12 m above the top of the spring?